[0053] An executable application, as used herein, comprises code or machine readable instructions for conditioning the processor to implement predetermined functions, such as those of an operating system, a context data acquisition system or other information processing system, for example, in response to user command or input. An executable procedure is a segment of code or machine readable instruction, sub-routine, or other distinct section of code or portion of an executable application for performing one or more particular processes. These processes may include receiving input data and/or parameters, performing operations on received input data and/or performing functions in response to received input parameters, and providing resulting output data and/or parameters.

[0054] A graphical user interface (GUI), as used herein, comprises one or more display images, generated by a display processor and enabling user interaction with a processor or other device and associated data acquisition and processing functions. The GUI also includes an executable procedure or executable application. The executable procedure or executable application conditions the display processor to generate signals representing the GUI display images. These signals are supplied to a display device which displays the image for viewing by the user. The processor, under control of an executable procedure or executable application, manipulates the GUI display images in response to signals received from the input devices. In this way, the user may interact with the display image using the input devices, enabling user interaction with the processor or other device.

[0055] The functions and process steps herein may be performed automatically or wholly or partially in response to user command. An activity (including a step) performed automatically is performed in response to one or more executable instructions or device operation without user direct initiation of the activity.

[0056] The system and processes of the figures are not exclusive. Other systems, processes and menus may be derived in accordance with the principles of the invention to accomplish the same objectives. Although this invention has been described with reference to particular embodiments, it is to be understood that the embodiments and variations shown and described herein are for illustration purposes only. Modifications to the current design may be implemented by those skilled in the art, without departing from the scope of the invention. As described herein, the various systems, subsystems, agents, managers and processes can be implemented using hardware components, software components, and/or combinations thereof. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

1. A computer-implemented method of optimized lattice partitioning of solid 3-D models for additive manufacturing, the method comprising:

receiving, by a computer, a 3-D model of an object to be printed;

receiving, by the computer, functional specifications indicating desired mechanical properties for portions of the object;

generating, by the computer, a plurality of lattice template structures based on the 3-D model;

generating, by the computer, a uniform grid structure of an internal surface of the object;

determining, by the computer, material behaviors for each of the plurality of lattice template structures using the functional specifications;

assigning, by the computer, the plurality of lattice template structures to locations in the uniform grid structure based on the material behaviors of the lattice template structures, thereby yielding a printable lattice.

2. The method of claim **1**, wherein the 3-D model comprises a computer-aided design (CAD) model of the object.

3. The method of claim **1**, wherein the material behaviors for each of the plurality of lattice template structures are determined by simulating the material behaviors of each lattice template structure at object scale with periodic boundary conditions.

4. The method of claim **1**, wherein the plurality of lattice template structures are generated using implicit volumetric representations of the object.

5. The method of claim **4**, wherein the implicit volumetric representations of the object comprise voxel occupancy grids.

6. The method of claim **4**, wherein the implicit volumetric representations of the object comprise level-sets of 3D scalar fields.

7. The method of claim **1**, wherein the plurality of lattice template structures are assigned to location in the uniform grid structure according to an optimization problem.

8. The method of claim **7**, wherein the optimization problem is solved using a graph and tree search technique.

9. The method of claim **8**, wherein the graph and tree search technique comprises a branch and bound technique.

10. An article of manufacture for optimized lattice partitioning of solid 3-D models for additive manufacturing, the article of manufacture comprising a non-transitory, tangible computer-readable medium holding computer-executable instructions for performing a method comprising:

generating a plurality of lattice template structures based on a user-specified 3-D model of an object to be printed;

generating a uniform grid structure of an internal surface of the object;

determining material behaviors for each of the plurality of lattice template structures using user-specified functional specifications indicating desired mechanical properties for portions of the object;

assigning the plurality of lattice template structures to locations in the uniform grid structure based on the material behaviors of the lattice template structures, thereby yielding a printable lattice.

11. The article of manufacture of claim **10**, wherein the user-specified 3-D model comprises a computer-aided design (CAD) model of the object.

12. The article of manufacture of claim **10**, wherein the material behaviors for each of the plurality of lattice template structures are determined by simulating the material behaviors of each lattice template structure at object scale with periodic boundary conditions.

13. The article of manufacture of claim **10**, wherein the plurality of lattice template structures are generated using implicit volumetric representations of the object.

14. The article of manufacture of claim **13**, wherein the implicit volumetric representations of the object comprise voxel occupancy grids.